

WHAT ARE THE NEUTRINO MASSES. DARK MATTER

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Abstract

The arguments connecting detections of a reason of difficulties of a solution of a problem of a cold dark matter are adduced.

Earlier in [1] we considered the leptonic vertex of electroweak theory:

$$L^{CC} = -\frac{g}{2\sqrt{2}}j_{\alpha}^{CC}W^{\alpha} + h.c., \quad (1)$$

where g is the SU(2) gauge coupling constant and CC current is

$$j_{\alpha}^{CC} = 2 \sum_{l=e,\mu,\tau} \bar{\nu}_e \gamma_{\alpha} l_L. \quad (2)$$

Thus the reaction was studied

$$\nu_e + n \rightarrow e^{-*} + p, \quad (3)$$

$$e^{-*} \rightarrow e^{-} + \gamma, \quad (4)$$

that is the reaction

$$\nu_e + n \rightarrow e^{-} + p + \gamma. \quad (5)$$

In [1] the parameters of reaction (3) with an electron off-mass-shell: mass of an exited electron, angular distribution, cross section and so on were studied. It should be noted that the process (3) and reaction

$$\nu_e + n \rightarrow e^{-} + p, \quad (6)$$

where e^{-} is on the mass shell, are not coherent.

In reaction (6) the leptonic vertex of the Lagrangian (1),(2) is on a mass surface. And in reaction (3) this vertex is half outside of a mass surface. There is a production of an exited (virtual) electron. The experiment demonstrates, that thus the leptonic vertex behaves similarly to as well as in reaction (6). Anyway it is not accepted in it to enter any form factors. It is difficult to present that the vertex (1),(2) acts as a certain semiconductor. When in one direction the production of the off-shell electron is possible. And in the other direction there is no production of the neutrino in an exited state. Therefore it is impossible to eliminate and capability of production a virtual neutrino in reverse reaction

$$e^- + p \rightarrow \nu_e^* + n, \quad (7)$$

where ν_e^* is neutrino off-mass-shell. And the parameters of this reaction can be like to parameters of reaction (3), including mass an exited neutrino ν_e^* and cross-section. And the reaction (7) will be incoherent of the reaction

$$e^- + p \rightarrow \nu_e + n, \quad (8)$$

as the direct reactions (3) and (6) are incoherent. The exited neutrino ν_e^* , as against ν_e , is outside of a mass surface, and therefore has other nature.

Thus there can be a rather large reduction of cross-section the production exited neutrino, than as contrasted to by reaction (5). As the exited electron rather fast descends from off-mass-shell at production of a photon. And exited neutrino long live as roaming propagator.

So at production the neutrino with small mass in some reaction is possible also production a neutrino with large mass in unbroken spectrum. The uncertainty principle reduces cross section of production a neutrino with large mass, probably, and is very strong.

The mechanism of operating of the uncertainty principle is not known. Can take place and absence of a capability the neutrino in general to be in an exited state.

Further we shall make an estimation about reducing effect of the uncertainty principle by consideration decay

$$K^+ \rightarrow \mu^{+*} + \nu_\mu, \quad (9)$$

$$\mu^{+*} \rightarrow \mu_\mu + \gamma. \quad (10)$$

In Fig.1 the distribution of width of decay of K^+ meson from a square of effective mass s of an exited μ^{+*} is adduced. On an abscissa axis the value $\Delta m_\mu = \sqrt{s} - m_\mu$ is adduced. By analogy with the previous arguing the following decay can be watched also

$$K^+ \rightarrow \mu^+ + \nu_\mu^*. \quad (11)$$

From Fig.1 it is visible, that the leading edge of shedule with mass an exited neutrino ~ 0.2 GeV will penetrate through prohibiting operating of uncertainty

principle. In definite sense it will be a certain mean mass ν^* of three satellites for three generations neutrinos. However, all this has only quality nature, creating reference points for further comprehension.

If the production ν^* takes place, it is possible, that it will give the contribution to a cold dark matter.

Within the limits of a nonrelativistic dilute gas the distribution function receives Boltzman kind. In simplification version ($T \ll m$) the expression for density of number of particles becomes [2] (further we use our calculations thys monography):

$$n_i = g_i \left(\frac{m_i T}{2\pi} \right)^{3/2} \exp(-m_i/T), \quad (12)$$

and density of energy is

$$\rho_i = m_i n_i. \quad (13)$$

Here g_i is number of degree of freedoms, for a neutrino $g_i = 6$, m_i - mass of heavy neutrino ν^* , we take $m_i = 0.2$ GeV, T is the present temperature. Supposing that $\rho_i = 0.2\rho_c$, ρ_c is the critical density, $\rho_c = 0.53 \times 10^{-5} \frac{\text{GeV}}{\text{cm}^3}$, we receive from equations (12), (13) $T_{\nu^*} \simeq 2$ MeV. For baryons is received $T_B \simeq 10$ MeV, at $g_B = 2$, $m_B = 1$ GeV. Let us remark, that the temperatures ν^* and baryons are proportional to their masses.

We do a crude estimate about cross section of production ν^* . Thus we are suspected that the density of number of particles a heavy and light neutrino are proportional to their cross sections of production or width of decais. Just,

$$\frac{n_{\nu^*}}{n_\nu} = x \times \alpha. \quad (14)$$

Here $n_{\nu^*} = 0.53 \times 10^{-5} \text{ cm}^{-3}$, $n_\nu = 112 \text{ cm}^{-3}$, x - the reducing factor of the uncertainty principle, α - the fine-structure constant. Thus, $x \simeq 10^{-5}$.

The detection of such small cross sections on experiment is represented unreal. From here and difficulty with detection of the candidates on a role of a cold dark matter. In a case, considered by us, of difficulty adds an unbroken spektrum of heavy neutrino ν^* . The problem of small cross sections of production of candidates on the cold dark matter remains and in discrete spectrum.

In the present article the arguments concerning problem of a cold dark matter are addused. More precisely than problem of a development on experiment of new massive particles of the special nature. In our article is showed, that for masses of these particles in the field of hundreds MeV, there is an experimental insuperability of their detection owing to small cross section of production.

References

- [1] V.P. Efrosinin, hep-th/0904.0542 (2009).
- [2] D.S. Gorbunov, V.A. Rubakov. The introducing in the theory of the early Universe. M. (2008).

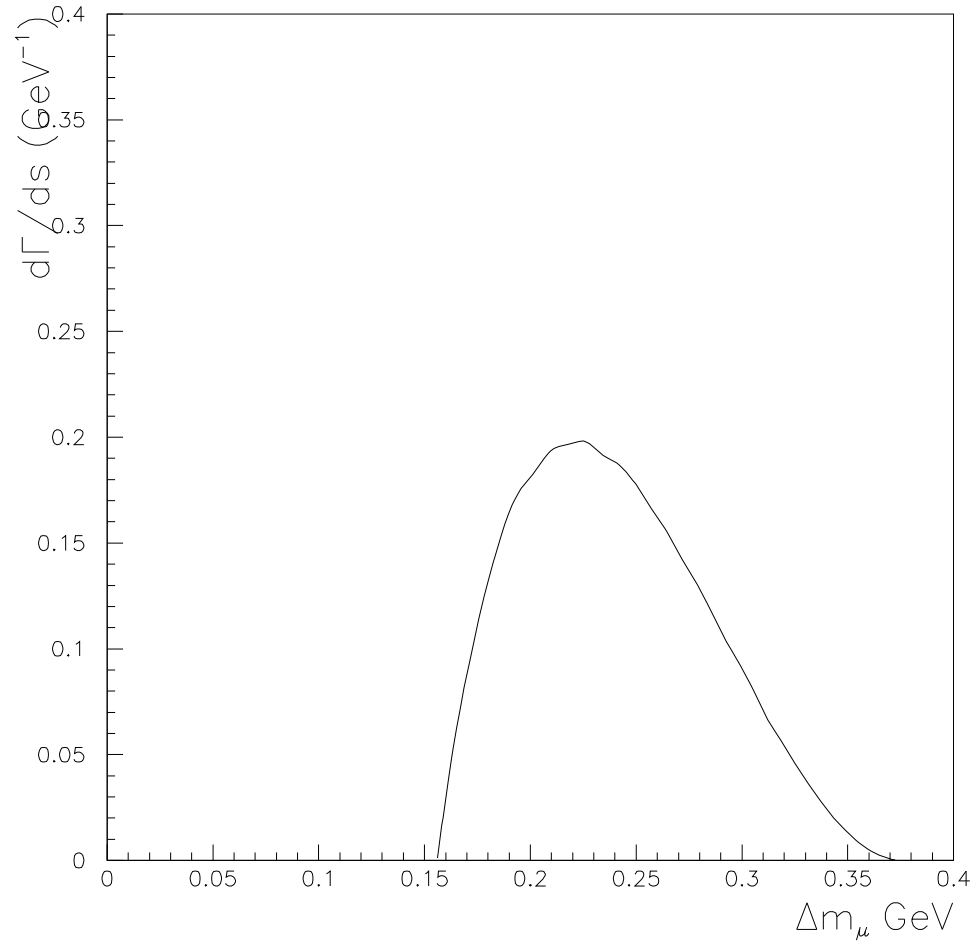


Figure 1:

Figure captions

Fig. 1. Distribution of width of decay of K^+ meson from a square of effective mass s of an exited μ^{+*} .